Docket # 4857/PCT
Inv.: Friedrich MUELLER

USPS EXPRESS MAIL
EV 511 024 426 US
MARCH 23 2005

10/528912
JC14 Rec'd PCT/PTO 23 MAR 2005

IN THE UNITED STATED PATENT AND TRADEMARK OFFICE

I, JILL SUSAN SCRAGG, B.A., A.I.L., declare

1. That I am a citizen of the United Kingdom of Great Britain and Northern Ireland, residing at "Mountain Ash",
56, Grove Road, Tring, Hertfordshire, HP23 5PD, England.
2. That I am well acquainted with the German and English languages.
3. That the attached is a true translation into the English language of the original International Patent Application No. **PCT/DE 2003/002860** dated **28.08.2003.**
4. That all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further than wilful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such wilful false statements may jeopardise the validity of the patent application in the United States of America or any patent issuing thereon.

Declared this **15th day of March 2005.**

JSScragg

JILL SUSAN SCRAGG

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LITERAL TRANSLATION OF PCT/DE2003/002860

Plasticating screw for an extruder or extrusion press, having a narrower land width in the transition region.

The invention relates to a plasticating screw for an extruder or an extrusion press having a high polymer melt through-put, in accordance with the features of the preamble of claim 1.

The invention relates in particular to the metering zone of such a plasticating screw. In plasticating screws, such a metering zone follows directly on the plasticating zone. This section of the screw, also known as the compression zone, thoroughly mixes the heat-softened granular material and conveys the plasticated material onwards under pressure towards an extruder nozzle. Intermixing in this zone constitutes an important task of an extruder screw, since the plasticated material is still inhomogeneous, that is, as yet unplasticated constituents could be present, which still have to be heat-softened. The inhomogeneity causes different shear forces at the walls of the screw and in the middle of the screw channel, whereby intimate mixing of the material is prevented and additionally pressure fluctuations in the material can arise. To remedy these problems, screws having a tapering screw channel and screws having guide webs in the main spiral have been proposed, for example, as well as plasticating screws having one or more of these above-mentioned features combined.

For example, such plasticating screws inter alia are already described in WO 00/34027, DE 196 34 162 C2 and US 5,599,098. WO 00/34027 describes the principle of increasing the channel depth in conjunction with guide members. In German patent 196 34 162 C2, an auxiliary screw is provided before the end of the plasticating screw in order to keep variations in edge thickness in strip-form material to a minimum. US patent 5,599,098 describes an extruder screw having a melt section for plastics material, the section consisting of screw channels that partially overlap. In this case, the flow of material at the start of the overlapping screw channels is divided into two partial melts, the flow rate and hence the pressure of

the material increasing because of the smaller overall cross-section. The newly starting screw channel is continued, whilst the original screw channel ends after ½ - 1 turn in the direction of flow. The drawback to this solution is that the available cross-section of the overlapping screw channels, especially at high material through-put, is reduced at least by one screw wall cross-section. At the same time, this is associated with a sudden increase in pressure.

It is an object of the present invention to construct for an extruder or for an extrusion press a plasticating screw for a high material through-put, in such a way that a change in volume of the conveying cross-section and hence a sudden increase in pressure in the polymer melt is prevented in the region of the flight change or changes. Suitable measures shall be provided for a slow build-up of any necessary pressure.

That object is achieved in accordance with the invention in that the cross-sections of the screw flights in the overlapping region are reduced in such a way that the combined conveying cross-section of the screw channels in the region of the overlapping screw flights corresponds to the conveying cross-section of the screw channel immediately before overlap of the screw flights. In particular the actual cross-sectional transition from single-flighted to twin-flighted conveying cross-section is configured so that there is no change in cross-section in this transition region either.

In order to achieve a slow pressure build-up in the compression zone, the invention provides for the at least one flight change in this zone to be constructed in accordance with the invention and, for pressure increase, for the shaft diameter of the screw to increase gradually in this zone. A sudden pressure build-up in the polymer melt at the start of the flight change is thereby avoided, and both a uniform flow of the polymer melt is achieved and the desired blending of the melt as a result of the flight change takes place. Changes of flight arranged according to the invention further downstream in the direction of flow can serve for further intensive intermixing of the polymer melt. For a desired pressure relief upstream of the

extruder nozzle, provision is furthermore made for the screw shaft to taper axially parallel over 360° in a region between two flight changes.

The invention is explained in detail below with reference to an exemplary embodiment. In the accompanying drawings:

Figure 1 shows a plasticating screw according to the invention with several overlaps of a first and second screw flight, and the associated developed view,

Figure 2 shows a developed view as per Figure 1,

Figure 3 shows the cross-section of a screw flight of a plasticating screw according to the invention,

Figure 4 shows the start of an overlap zone.

Figure 1 shows the plasticating screw 1 according to the invention for plasticating a plasticatable polymer material, having several overlaps of a first and second screw channel 4, 5 in the direction of flow 3 of the material from right to left, at least one flight change occurring in the region of the compression zone **DZ**; further flight changes can be provided upstream and downstream of a pressure-reduction zone **DMZ**. A polymer is fed on the right-hand side to the plasticating screw in a filling zone **FZ** of the plasticating screw 1 and is largely plasticated in the adjoining melt zone **SZ**. In the compression zone **DZ** adjoining to the left, a gradual enlargement of the screw shaft diameter reduces the channel depth **T** of the screw channel 2 and hence increases the pressure of the melt. The effect of the flight change according to the invention provided in this region is that the melt is thoroughly mixed in order to heat-soften any as yet not heat-softened polymer constituents, with no sudden pressure increase at the start of this flight change or in the further course thereof. Further flight changes according to the invention are

arranged in a mixing zone **MZ**, in order to achieve even more intensive mixing of the melt. In a pressure-reduction zone **DMZ**, provision of which is optional, the channel depth is reduced, for example, axially parallel, and hence pressure relief is achieved before the melt is fed via a metering zone **ZM** to the nozzle.

Fig. 2 shows the associated developed view 6. The ratio of channel widths **b1, b2** in the overlapping region 7 is about 1:2.

Figure 3 shows the cross-section of a flight 4 of a plasticating screw 1 according to the invention.

Figure 4 shows as detail **X**, in plan view, the start of a flight overlap with a cross-sectional change in the flights 4, 5, the flight width outside the overlap being **d** and the flight widths within the overlap being ½ **d**.